

09-01-00

A

08/31/00
10:781 U.S. PTO

Please type a plus sign (+) inside this box → ☐


PTO/SB/05 (1/98)
Approved for use through 09/30/2000 OMB 0651-0032
Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

UTILITY PATENT APPLICATION TRANSMITTAL <small>(Only for new nonprovisional applications under 37 CFR 1.53(b))</small>	Attorney Docket No.	4372US (99-1187)
	First Inventor or Application Identifier	Theodore M. Taylor
	Title	See 1 in Addendum
	Express Mail Label No.	EL700255282US

APPLICATION ELEMENTS <small>See MPEP chapter 600 concerning utility patent application contents.</small>	ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231
--	---

1. <input checked="" type="checkbox"/> * Fee Transmittal Form (e.g., PTO/SB/17) <small>(Submit an original, and a duplicate for fee processing)</small> 2. <input checked="" type="checkbox"/> Specification [Total Pages 19] <small>(preferred arrangement set forth below)</small> - Descriptive title of the Invention - Cross References to Related Applications - Statement Regarding Fed sponsored R & D - Reference to Microfiche Appendix - Background of the Invention - Brief Summary of the Invention - Brief Description of the Drawings (if filed) - Detailed Description - Claim(s) - Abstract of the Disclosure 3. <input checked="" type="checkbox"/> Drawing(s) (35 U.S.C. 113) [Total Sheets 6] 4. Oath or Declaration [Total Pages 1] a. <input checked="" type="checkbox"/> Newly executed (original or copy) b. <input type="checkbox"/> Copy from a prior application (37 C.F.R. § 1.63(d)) <small>(for continuation/divisional with Box 17 completed)</small> <small>[Note Box 5 below]</small> i. <input type="checkbox"/> DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b). 5. <input type="checkbox"/> Incorporation By Reference (useable if Box 4b is checked) The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference therein.	6. <input type="checkbox"/> Microfiche Computer Program (Appendix) 7. Nucleotide and/or Amino Acid Sequence Submission (if applicable, all necessary) a. <input type="checkbox"/> Computer Readable Copy b. <input type="checkbox"/> Paper Copy (identical to computer copy) c. <input type="checkbox"/> Statement verifying identity of above copies
---	---

17. If a CONTINUING APPLICATION , check appropriate box, and supply the requisite information below and in a preliminary amendment: <input type="checkbox"/> Continuation <input type="checkbox"/> Divisional <input type="checkbox"/> Continuation-in-part (CIP) of prior application No: _____ / _____ Prior application information: Examiner _____ Group / Art Unit: _____	ACCOMPANYING APPLICATION PARTS 8. <input checked="" type="checkbox"/> Assignment Papers (cover sheet & document(s)) 9. <input checked="" type="checkbox"/> 37 C.F.R. § 3.73(b) Statement (when there is an assignee) <input type="checkbox"/> Power of Attorney 10. <input type="checkbox"/> English Translation Document (if applicable) 11. <input type="checkbox"/> Information Disclosure Statement (IDS)/PTO-1449 <input type="checkbox"/> Copies of IDS Citations 12. <input type="checkbox"/> Preliminary Amendment 13. <input checked="" type="checkbox"/> Return Receipt Postcard (MPEP 503) <small>(Should be specifically itemized)</small> * Small Entity 14. <input type="checkbox"/> Statement(s) <input type="checkbox"/> Statement filed in prior application, Status still proper and desired (PTO/SB/09-12) 15. <input type="checkbox"/> Certified Copy of Priority Document(s) (if foreign priority is claimed) 16. <input type="checkbox"/> Other: _____ <small>* A new statement is required to be entitled to pay small entity fees, except where one has been filed in a prior application and is being relied upon.</small>
---	--

18. CORRESPONDENCE ADDRESS <input checked="" type="checkbox"/> Customer Number or Bar Code Label  or <input type="checkbox"/> Correspondence address below <small>(Insert Customer No. or Attach bar code label here)</small>					
Name	Brick G. Power				
	Trask Britt				
Address	P.O. Box 2550				
City	Salt Lake City	State	Utah	Zip Code	84102
Country	U.S.A.	Telephone	(801) 532-1922	Fax	(801) 531-9168

Name (Print/Type)	Brick G. Power	Registration No. (Attorney/Agent)	38,581
Signature		Date	08/31/00

Burden Hour Statement This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231 DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

10:542 U.S. PTO
09/652878
08/31/00

Addendum

1. SUBPAD SUPPORT FOR A POLISHING APPARATUS INCLUDING A NON-ADHESIVE SUBPAD SECURING ELEMENT, ASSEMBLIES INCLUDING THE SUPPORT AND A SUBPAD, POLISHING APPARATUS INCLUDING THE SUBPAD SUPPORT, AND METHODS

FEE TRANSMITTAL

for FY 2000

Patent fees are subject to annual revision.
Small Entity payments must be supported by a small entity statement,
otherwise large entity fees must be paid. See Forms PTO/SB/09-12.
See 37 C.F.R. §§ 1.27 and 1.28.

TOTAL AMOUNT OF PAYMENT (\$1110.00

Complete if Known

Application Number	Not yet assigned
Filing Date	August 31, 2000
First Named Inventor	Theodore M. Taylor
Examiner Name	Unknown
Group / Art Unit	Unknown
Attorney Docket No.	4372US (99-1187)

METHOD OF PAYMENT (check one)

1. ☒ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

Deposit Account Number 20-1469

Deposit Account Name Trask Britt

☒ Charge Any Additional Fee Required
Under 37 CFR §§ 1.16 and 1.17

2. ☒ Payment Enclosed:
☒ Check ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
101 690	201 345	Utility filing fee	690
106 310	206 155	Design filing fee	0
107 480	207 240	Plant filing fee	0
108 690	208 345	Reissue filing fee	0
114 150	214 75	Provisional filing fee	0

SUBTOTAL (1) (\$) 690.00

2. EXTRA CLAIM FEES

Total Claims	Extra Claims	Fee from below	Fee Paid
39	-20** = 19	18	342
4	-3** = 1	78	78
Multiple Dependent		0	0

**or number previously paid, if greater; For Reissues, see below

Large Entity Small Entity

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description
103 18	203 9	Claims in excess of 20
102 78	202 39	Independent claims in excess of 3
104 260	204 130	Multiple dependent claim, if not paid
109 78	209 39	** Reissue independent claims over original patent
110 18	210 9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$) 420.00

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
105 130	205 65	Surcharge - late filing fee or oath	
127 50	227 25	Surcharge - late provisional filing fee or cover sheet	
139 130	139 130	Non-English specification	
147 2,520	147 2,520	For filing a request for reexamination	
112 920*	112 920*	Requesting publication of SIR prior to Examiner action	
113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action	
115 110	215 55	Extension for reply within first month	
116 380	216 190	Extension for reply within second month	
117 870	217 435	Extension for reply within third month	
118 1,360	218 680	Extension for reply within fourth month	
128 1,850	228 925	Extension for reply within fifth month	
119 300	219 150	Notice of Appeal	
120 300	220 150	Filing a brief in support of an appeal	
121 260	221 130	Request for oral hearing	
138 1,510	138 1,510	Petition to institute a public use proceeding	
140 110	240 55	Petition to revive - unavoidable	
141 1,210	241 605	Petition to revive - unintentional	
142 1,210	242 605	Utility issue fee (or reissue)	
143 430	243 215	Design issue fee	
144 580	244 290	Plant issue fee	
122 130	122 130	Petitions to the Commissioner	
123 50	123 50	Petitions related to provisional applications	
126 240	126 240	Submission of Information Disclosure Stmt	
581 40	581 40	Recording each patent assignment per property (times number of properties)	
146 690	246 345	Filing a submission after final rejection (37 CFR § 1.129(a))	
149 690	249 345	For each additional invention to be examined (37 CFR § 1.129(b))	

Other fee (specify) _____

Other fee (specify) _____

* Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$) _____

SUBMITTED BY

Name (Print/Type)	<u>Brick G. Power</u>	Registration No. (Attorney/Agent)	<u>38,581</u>	Telephone	<u>(801) 532-1922</u>
Signature	<u>Brick G. Power</u>	Date	<u>08/31/2000</u>		

WARNING:

Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

Burden Hour Statement This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231

PATENT
Attorney Docket 4372US (99-1187)

NOTICE OF EXPRESS MAILING

Express Mail Mailing Label Number: EL700255282US

Date of Deposit with USPS: August 31, 2000

Person making Deposit: Amanda Trulson

APPLICATION FOR LETTERS PATENT

for

**SUBPAD SUPPORT FOR A POLISHING APPARATUS INCLUDING
A NON-ADHESIVE SUBPAD SECURING ELEMENT, ASSEMBLIES
INCLUDING THE SUPPORT AND A SUBPAD, POLISHING APPARATUS
INCLUDING THE SUBPAD SUPPORT, AND METHODS**

Inventor:
Theodore M. Taylor

Attorneys:
Brick G. Power
Registration No. 38,581
Joseph A. Walkowski
Registration No. 28,765
TRASK BRITT
P.O. Box 2550
Salt Lake City, Utah 84110
(801) 532-1922

**SUBPAD SUPPORT FOR A POLISHING APPARATUS INCLUDING
A NON-ADHESIVE SUBPAD SECURING ELEMENT, ASSEMBLIES
INCLUDING THE SUPPORT AND A SUBPAD, POLISHING APPARATUS
INCLUDING THE SUBPAD SUPPORT, AND METHODS**

5

BACKGROUND OF THE INVENTION

Field of the Invention: The present invention relates to subpad supports in web format and belt format polishing apparatus. Particularly, the present invention relates to subpad supports including non-adhesive subpad securing elements and to polishing apparatus including the subpad supports. The present invention also relates to assemblies including a subpad and a subpad support of the present invention, as well as to methods of assembling a subpad with, securing a subpad to, removing a subpad from, and replacing a subpad on a subpad support of the present invention.

State of the Art: Web format polishing apparatus typically include a wafer support and a polishing pad. The wafer support is typically configured to hold a semiconductor wafer, to bring the wafer into contact with the polishing pad, and to rotate the wafer while the wafer is in contact with the polishing pad so as to create friction between the wafer and the polishing pad and, thereby, effect polishing of one or more layers on the wafer. As used herein, the term "polishing" encompasses removal of material from a semiconductor wafer. "Polishing", as used herein, need not achieve a certain surface finish or planarity. A subpad, located on the opposite side of the polishing pad from the wafer support, is configured to prevent the formation defects on a wafer secured to the wafer support during polishing thereof, as well as to cushion the polishing pad and wafer being polished so as to prevent damage to the wafer during polishing. The subpad is held in place by a subpad support and, conventionally, has been secured to the subpad supports by way of an adhesive material.

Fresh portions of a web format, film-type polishing pad are supplied by a supply reel of the web format polishing apparatus, while used portions of the web format polishing pad are taken up on a take-up reel of the apparatus. Typically, the positions of supply reels and take-up reels on conventional web format polishing apparatus are fixed relative to the remainder of these apparatus.

As a subpad wears, it must be replaced. Typically, in order to remove a subpad from a web format polishing apparatus, the web format polishing pad must either be cut or slack formed in the polishing pad by, for example, loosening the web format pad from the supply reel of the polishing apparatus without winding the pad around the take-up reel. Creating slack in a web format polishing pad facilitates pulling of the polishing pad away from the subpad. When a web format polishing pad is cut or given slack, it is common that a portion of the polishing pad is damaged and, thus, that portion of the polishing pad is wasted. In addition, as the subpad is typically secured to the subpad support with an adhesive material, removal of the subpad from the subpad support is often very difficult since the subpad may rip or need to be scraped from the subpad support.

Belt format polishing apparatus are very similar to web format polishing apparatus, with the major exception being that the polishing pad is in the format of a continuous belt that may be recycled, rather than a web that is supplied from a supply reel and, after use, taken away on a take-up reel. In order to gain access to a subpad of a belt format polishing apparatus, the belt format polishing pad is removed from the polishing apparatus, which is time consuming and may result in damage to the pad, or the pad may be stretched, which may also damage the pad. Damage to a belt format polishing pad to remove and replace a subpad is, however, even more costly than damage to a web format polishing pad because a damaged belt format polishing pad must be completely replaced.

The inventor is not aware of a subpad support to which a subpad may be non-adhesively secured and from which a subpad may be readily removed. Moreover, the inventor is not aware of a web format or belt format polishing apparatus configured to facilitate subpad removal and replacement without a significant potential for damaging the polishing pad.

BRIEF SUMMARY OF THE INVENTION

The present invention includes a subpad support with a retention element for removably, non-adhesively securing a subpad thereto, as well as web format and belt format polishing apparatus including the subpad support.

The subpad support of the present invention includes a subpad supporting surface and a subpad retention element. The subpad supporting surface is configured to receive a backing of a subpad. The subpad retention element is configured to non-adhesively secure a subpad to the subpad support. The subpad retention element may be configured to at least partially engage a periphery of a subpad, mechanically engage a backing of a subpad, apply a negative pressure to a backing of a subpad through the subpad support, or otherwise non-adhesively secure a subpad to the subpad support.

The subpad support may also include one or more lips, columns, or other lateral confinement structures protruding from the supporting surface thereof and that are configured and located so as to at least partially prevent lateral movement of a subpad relative to the subpad support to which the subpad is secured.

To facilitate the releasable securing of a subpad to the subpad support, the subpad may include a substantially rigid structure on the backing thereof. The substantially rigid structure may be secured to the backing of the subpad or formed by a denser region of the material of the subpad. If the substantially rigid structure is secured to the backing of the subpad, a material such as a polymer, a metal, a glass, or a ceramic may be used as the substantially rigid structure.

Polishing apparatus including the subpad of the present invention are also within the scope of the present invention. A polishing apparatus incorporating teachings of the present invention may include a component that at least partially moves the polishing pad of the apparatus away from the subpad support thereof, as well as a subpad secured to the subpad support. In a web format polishing apparatus, such a component may include, by way of example only and not to limit the scope of the present invention, a releasable latch that secures one or both of the supply reel and the take-up reel to the remainder of the polishing apparatus. In addition, such an exemplary polishing apparatus may also include a member that effects the controlled movement of one or both of the supply and take-up reels and, thus, the polishing pad away from the remainder of the polishing apparatus. Exemplary members include, but are not limited to, one or more hydraulic pistons, gear drive mechanisms, and screw drive mechanisms.

Methods of assembling and securing a subpad to the subpad support, removing a subpad from the subpad support, and replacing a subpad on the subpad support are also within the scope of the present invention, as are methods of at least partially moving a polishing pad away from a subpad support so as to facilitate such assembly, securing, removal, and replacing.

Other features and advantages of the present invention will become apparent to those of skill in the art through consideration of the ensuing description, the accompanying drawings, and the appended claims.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a perspective assembly view illustrating an exemplary embodiment of a subpad support incorporating teachings of the present invention and a subpad configured to be secured to the subpad support by way of complementary threads on the subpad and the subpad support;

FIG. 2 is a perspective view of another exemplary embodiment of an assembly of a subpad support that includes a clamping member configured to engage at least a portion of a periphery of a subpad;

FIG. 3 is a cross-sectional representation of an embodiment of a subpad support-subpad assembly wherein the subpad support includes clamping members configured to engage recessed portions of a complementary subpad;

FIG. 4 is a cross-sectional representation of yet another exemplary embodiment of an assembly including a subpad support and a subpad of the present invention, wherein the subpad support is configured to apply a relatively negative pressure to the backside of the subpad to secure the subpad thereto;

FIG. 5 is a partial perspective view of an embodiment of a subpad support configured to slidingly engage a complementarily configured subpad;

FIG. 6 is a partial top view of an embodiment of subpad support with recesses and slots configured to receive tabs protruding from the periphery of a complementarily configured subpad;

FIGs. 7A and 7B illustrate still another embodiment of subpad support and subpad incorporating teachings of the present invention, wherein the subpad support includes keyhole-shaped recesses configured to receive headed studs protruding from the backing of the subpad;

FIGs. 8 and 8A are schematic representations of a belt format polishing apparatus incorporating teachings of the present invention, depicting at least partial movement of the polishing pad thereof away from the subpad support thereof; and

FIGs. 9 and 9A are schematic representations of a belt format polishing apparatus incorporating teachings of the present invention, depicting movement of the polishing pad thereof away from the subpad support thereof.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, a first exemplary embodiment of a subpad support 10 incorporating teachings of the present invention is illustrated. Subpad support 10 includes a supporting surface 12 and a retention element 14. Supporting surface 12 is configured to engage a backing 22 of a subpad 20. Retention element 14 is configured to secure subpad 20 to subpad support 10. Subpad support 10 may also include one or more lips 16 protruding therefrom and positioned so as to facilitate the alignment of subpad 20 with subpad support 10 during assembly thereof or to at least partially prevent lateral movement of subpad 20 relative to supporting surface 12 during use.

Retention element 14, as illustrated, is configured to mechanically engage a corresponding, complementary structure of a known type, such as the illustrated threaded locking element 24, on backing 22 of subpad 20. Upon interconnecting retention element 14 and locking element 24 and rotating locking element 24 relative to retention element 14, retention element 14 and locking element 24 interlock so as to secure subpad 20 to subpad support 10.

As illustrated, locking element 24 is secured to a backing 22 of subpad 20 by known means, such as with a suitable adhesive. Alternatively, locking element 24 may be integral with backing 22. Backing 22 may be formed from a relatively denser region of the same material as the remainder of subpad 20, which may be formed from a material

such as closed-cell polyurethane foam, and may be integral therewith, or may comprise a separate element secured to the remainder, or contact surface 23, of subpad 20.

Alternatively, backing 22 may be formed from another polymer (e.g., polycarbonate), a metal, a ceramic, or any other suitable material, different from the material of contact surface 23, which cushions a wafer during polishing thereof. A backing 22 that is separate from the remainder of subpad 20 may be secured thereto as known in the art, such as by use of adhesives or by thermally bonding contact surface 23 of subpad 20 to backing 22 thereof.

Turning now to FIG. 2, another embodiment of a subpad support 10' according to the present invention is illustrated. Subpad support 10' includes a supporting surface 12' and a retention element 14'. Again, supporting surface 12' is configured to engage a backing 22' of a subpad 20' to be assembled with subpad support 10'. In addition, retention element 14' is configured to mechanically secure a subpad 20' to subpad support 10'.

Retention element 14' of subpad support 10' includes a clamping member 15' that is configured to be positioned around the periphery 21' of at least a rigid backing 22' of subpad 20' upon assembly of subpad 20' with subpad support 10' and to be biased against periphery 21' so as to secure backing 22' against supporting surface 12' while substantially maintaining the planarity of contact surface 23' of subpad 20' and, thus, the planarity of an area of a polishing pad to be supported by subpad 20'. In addition, clamping element 15' at least partially prevents lateral movement of subpad 20' relative to supporting surface 12'.

Again, subpad 20' includes a cushioning contact surface 23' and a substantially rigid backing 22'. Backing 22' may be formed from a dense region of the same material as contact surface 23' or from another material, such as another polymer, a metal, a ceramic, or another suitable material. If backing 22' is formed from the same material as contact surface 23', backing 22' may be integral with contact surface 23' or a separate element that is secured to contact surface 23'. Of course, if another material is used to form backing 22', backing 22' is secured to contact surface 23'. Backing 22' and contact surface 23' of subpad 20' may be secured to one another by known means, such as by use

of a suitable adhesive material or by thermally bonding backing 22' and contact surface 23' to one another.

Another embodiment of subpad support 10" is shown in FIG. 3. Subpad support 10" includes a supporting surface 12" that is configured to engage a backing 22" of a subpad 20". Subpad support 10" also includes retention elements 14" that are configured to clamp onto corresponding receptacles 26" recessed in periphery 21" of subpad 20". Each receptacle 26", along with backing 22", forms a lip 27", which a corresponding retention element 14" engages upon being disposed in a clamping position. Upon engaging lips 27" with retention elements 14", backing 22" of subpad 20" is held against supporting surface 12" of subpad support 10".

FIG. 4 illustrates yet another embodiment of a subpad support 10''' incorporating teachings of the present invention. As the previously described subpad support embodiments, subpad support 10''' includes a supporting surface 12''' and a retention element 14'''. Subpad support 10''' may also include one or more columns 16'', lips, or other structures protruding from supporting surface 12'''. Columns 16''' are preferably configured so as to laterally surround a periphery 21''' of subpad 20''' upon assembly thereof with subpad support 10'''. Columns 16''' are configured to align a subpad 20''' with subpad support 10'', to substantially laterally surround a subpad 20''' assembled with subpad support 10'', or to at least substantially inhibit subpad 20''' from moving laterally relative to supporting surface 12'''.

Supporting surface 12''' is configured to engage a backing 22''' of a subpad 20''' upon assembly of subpad 20''' with subpad support 10'''.

Retention element 14''' employs a negative pressure to secure a subpad 20''' to subpad support 10'''. Retention element 14''' includes one or more apertures 30 formed through subpad support 10''' from supporting surface 12''' to an opposite surface 18'''. Apertures 30 communicate with a negative pressure, or vacuum, source 34 by way of a negative pressure conduit 32 between apertures 30 and negative pressure source 34. As illustrated in FIG. 4, retention element 14''' also includes a chamber 35 formed within subpad support 10''' and communicating with each aperture 30. In turn, chamber 35 communicates with conduit 32 by way of a connection port 37 on subpad support 10'''.

Alternatively, each aperture 30 of a retention element 14''' incorporating teachings of the present invention may communicate negative pressure source 34 by way of separate conduits 32. In any event, retention element 14''' secures a subpad 20''' to supporting surface 12''' of subpad support 10''' by applying a negative pressure to backing 22''' of subpad 20''' through apertures 30 formed in subpad support 10'''.

With reference to FIG. 5, a subpad support 110 configured to receive a rectangular subpad 120 is illustrated. Subpad support 110 includes a recessed retention element 114 that is continuous with at least one end of subpad support 110. Retention element 114 includes elongated retention slots 115 at opposite sides thereof. Retention slots 115 are configured to engage corresponding, opposite ends of a complementarily configured subpad 120 upon sliding subpad 120 in the direction of arrow A to position backing 122 of subpad 120 in substantial contact with supporting surface 112 of subpad support 110 and to effect engagement of subpad 120 by retention element 114. Accordingly, retention slots 115 may extend laterally beneath a supporting surface 112 of subpad support 110 so as to engage thin or tapered edges 125 of subpad 120.

As shown in FIG. 6, a subpad support 110' incorporating teachings of the present invention may include a subpad receptacle 115' formed in a supporting surface 112' of subpad support 110' and configured to receive at least a backing (not shown) of a complementarily configured subpad 120'. In the illustrated embodiment of subpad support 110', retention elements 114' are disposed around the periphery 116' of receptacle 115' and include recesses 114a' and slots 114b' that are continuous with receptacle 115'. Recesses 114a' are formed in supporting surface 112' and, upon introduction of the backing of subpad 120' into receptacle 115', are configured to receive tabs 128' that protrude laterally from periphery 121' of subpad 120', in a plane substantially parallel to the plane of subpad 120', and are located proximate the backing of subpad 120'. Retention elements 114' also include slots 114b' that are continuous with recesses 114a' and that underlie supporting surface 112'. Upon sliding of subpad 120' in the direction of arrow B relative to subpad support 110', retention tabs 128' are positioned within slots 114b' and subpad 120' is engaged by subpad support 110'.

Another embodiment of subpad support 110" and complementary subpad 120" incorporating teachings of the present invention is illustrated in FIGs. 7A and 7B. Subpad support 110" includes a supporting surface 112" with a series of keyhole-shaped retention elements 114" formed therein. Retention elements 114" include an enlarged end 114a" and a narrower, elongated slot 114b" formed through and continuous with supporting surface 112", as well as a receptacle 114c" underlying supporting surface 112", enlarged end 114a", and elongated slot 114b". Enlarged end 114a" of each retention element 114" is configured to receive a head 128a" of a corresponding retention stud 128" that protrudes from a backing 122" of subpad 120". Slot 114b" is narrower than end 114a" and is configured to receive a neck 128b" of retention stud 128" as head 128a" is positioned within the portion of receptacle 114c" that underlies slot 114b". As shown in FIGs. 7A and 7B, retention elements 114", including slot 114b" and receptacle 114c" thereof, may be slightly curved so as to facilitate engagement of a subpad 120" by subpad support 110" upon slight rotation of subpad 120" in the direction of arrow C relative to subpad support 110". Alternatively, the slot and receptacle of a retention element 114" may be angled so as to facilitate the retention of a complementary retention stud 128" therein.

Referring now to FIGs. 8, 8A, 9, and 9A, subpad support 10 may be included in a web format polishing apparatus 40, illustrated in FIGs. 8 and 8A, or in a belt-type polishing apparatus 40', shown in FIGs. 9 and 9A.

As shown in FIG. 8, subpad support 10 of polishing apparatus 40 is positioned adjacent a web format polishing pad, which is referred to herein and known in the art as a "web" 42. Polishing apparatus 40 also includes a supply reel 44 from which fresh portions of web 42 are supplied, as well as a take-up reel 46, which receives previously used portions of web 42. In use of polishing apparatus 40, a semiconductor device structure 1 is brought into frictional contact with web 42, on an opposite side thereof from subpad support 10. As semiconductor device structure 1 is polished at least in part by web 42, the portion of web 42 that is being used to polish semiconductor device structure 1 is supported from beneath by a subpad 20 assembled with subpad support 10.

Web 42 and subpad 20 of polishing apparatus 40 are positioned in close proximity to one another. Polishing apparatus 40 includes a polishing pad movement element 50, which is also referred to herein as a subpad access element, to effect the movement of web 42 at least partially away from subpad 20 so as to avoid physical contact of an operator with web 42 while facilitating access to a worn or damaged subpad 20. As illustrated in FIGs. 8 and 8A, polishing pad movement element 50 is associated with at least one of supply reel 44 and take-up reel 46 of polishing apparatus 40. Polishing pad movement element 50 preferably effects the movement of web 42 away from subpad support 10 in a controlled manner and at a controlled rate to minimize stress on web 42. By way of example, and not to limit the scope of the present invention, known apparatus that may be used as polishing pad movement element 50 include hydraulic pistons, screw drive motors, gear drive motors, and the like. Polishing apparatus 40 may also include a latch 52 or other known releasable locking element that is configured to prevent movement of web 42 away from subpad 20 and subpad support 10 when such movement is not desired. In addition, if polishing pad movement element 50 moves one end 42a of web 42 while the other end 42b of web 42 remains substantially stationary, end 42b may be pivotally connected to apparatus 40, such as by a pivot pin 54 that connects one conveyor support 48 to a fixed structure of apparatus 40 or otherwise, as known in the art.

Referring now to FIGs. 9 and 9A, polishing apparatus 40' includes a belt format polishing pad, which is referred to herein and known in the art as a "belt" 42'. Belt 42' may be continually moved around conveyor supports 48 to supply fresh or newly conditioned portions of belt 42' for use in polishing a semiconductor device structure 1. As semiconductor device structure 1 is brought into frictional contact with belt 42' to effect polishing of semiconductor device structure 1, the portion of belt 42' that is being used to polish semiconductor device structure 1 is supported from beneath by a subpad 20 assembled with subpad support 10.

As shown in FIG. 9, belt 42' and subpad 20 are positioned very closely to one another. In order to avoid physical contact by an operator with belt 42' to gain access to a worn or damaged subpad 20 to remove and replace the same on subpad support 10, polishing apparatus 40' is supplied with a polishing pad movement element 50' that

effects the movement of belt 42' at least partially away from subpad 20. As illustrated in FIGs. 9 and 9A, polishing pad movement element 50' is associated with at least one conveyor component 49 of polishing apparatus 40'. Polishing pad movement element 50' preferably effects the movement of belt 42' away from subpad support 10 in a controlled manner and at a controlled rate. Examples of known apparatus that are useful as polishing pad movement element 50' include hydraulic cylinders, pneumatic cylinders, screw drive motors, gear drive motors, and the like. Polishing apparatus 40' may also include a latch 52' configured to prevent movement of belt 42' away from subpad 20 and subpad support 10 when such movement is not desired. In addition, if polishing pad movement element 50' moves one end 42a' of belt 42' while the other end 42b' of belt 42' remains substantially stationary, end 42b' may be pivotally connected to apparatus 40', such as by a pivot pin 54' that connects one conveyor support 48 to a fixed structure of apparatus 40' or otherwise, as known in the art.

An example of the manner in which a subpad 20 is removed from subpad support 10 of polishing apparatus 40' and replaced on subpad support 10 is described with continued reference to FIGs. 9 and 9A. Latch 52' of polishing apparatus 40' is positioned so as to facilitate the movement end 42a' of belt 42' while end 42b' of belt 42' pivots around pivot pin 54', thereby at least partially moving belt 42' away from subpad 20 and subpad support 10 so as to facilitate access to subpad 20. Belt 42' is then at least partially moved away from subpad 20 and subpad support 10 with the assistance of or by way of polishing pad movement element 50'. Of course, apparatus 40' could be configured such that both ends 42a', 42b' of belt 42' may be moved so as to effect movement of belt 42' away from subpad support 10. Next, subpad 20 is released by retention element 12 (*see, e.g.*, FIGs. 1-3) and disassembled from subpad support 10. Another subpad 20 may be assembled with subpad support 10 and secured thereto by retention element 12. Belt 42' may then be repositioned adjacent subpad 20 and subpad support 10 with the assistance or by way of polishing pad movement element 50'. Latch 52' may be repositioned so as to secure belt 42' in place.

Although the foregoing description contains many specifics, these should not be construed as limiting the scope of the present invention, but merely as providing illustrations of some of the presently preferred embodiments. Similarly, other embodiments of the invention may be devised which do not depart from the spirit or scope of the present invention. Features from different embodiments may be employed in combination. The scope of the invention is, therefore, indicated and limited only by the appended claims and their legal equivalents, rather than by the foregoing description. All additions, deletions and modifications to the invention as disclosed herein which fall within the meaning and scope of the claims are to be embraced thereby.

CLAIMS

What is claimed is:

1. An apparatus for polishing one or more layers of a semiconductor device structure, comprising:

5 a polishing pad;

a subpad support located adjacent said polishing pad, said subpad support including a subpad retention element; and

10 a subpad removably secured to said subpad support by way of said subpad retention element, said subpad being located between said subpad support and said polishing pad.

2. The apparatus of claim 1, wherein said polishing pad comprises one of a web format polishing pad and a belt format polishing pad.

15 3. The apparatus of claim 1, wherein said subpad retention element comprises a clamp configured to retain at least a portion of a periphery of said subpad.

20 4. The apparatus of claim 1, wherein said subpad retention element comprises negative pressure applicable to a backing of said subpad through said subpad support.

5. The apparatus of claim 1, wherein said subpad retention element mechanically engages a complementary structure on a backing of said subpad.

25 6. The apparatus of claim 1, further comprising a substantially rigid structure on a backing of said subpad.

7. The apparatus of claim 6, wherein said substantially rigid structure is secured to said backing of said subpad.

8. The apparatus of claim 6, wherein said substantially rigid structure comprises a polymer.

5 9. The apparatus of claim 6, wherein said substantially rigid structure comprises a metal.

10 10. The apparatus of claim 6, wherein said substantially rigid structure comprises a dense region of said subpad at said backing thereof.

10 11. The apparatus of claim 1, wherein said subpad support comprises at least one lip configured to at least partially prevent lateral movement of a subpad assembled with and secured to said subpad support.

15 12. The apparatus of claim 11, wherein said at least one lip substantially completely laterally surrounds a peripheral edge of said subpad.

20 13. The apparatus of claim 1, wherein a backing of said subpad is substantially free of adhesive material.

20 14. The apparatus of claim 1, including a subpad access element.

25 15. The apparatus of claim 14, wherein said subpad access element is configured to at least partially move said polishing pad away from said subpad support.

25 16. The apparatus of claim 14, wherein said subpad support access element moves a polishing pad support so as to at least partially move said polishing pad away from said subpad support.

30 17. A subpad support for use in an apparatus for polishing one or more layers of a semiconductor device structure, comprising a subpad retention element.

18. The subpad support of claim 17, wherein said subpad retention element is configured to removably retain a subpad.

19. The subpad support of claim 17, wherein said retention element mechanically engages a corresponding feature on a backing of a subpad to be assembled with the subpad support.

20. The subpad support of claim 17, wherein said retention element is configured to apply a negative pressure to a backing of a subpad engaged by said retention element.

21. The subpad support of claim 17, wherein said subpad retention element comprises a clamp element configured to engage at least a portion of a periphery of a subpad assembled with the subpad support.

22. The subpad support of claim 17, comprising a lip configured to at least partially prevent lateral movement of a subpad assembled with the subpad support.

23. The subpad support of claim 22, wherein said lip is configured to substantially completely surround a peripheral edge of said subpad.

24. A method for replacing a subpad of an apparatus for polishing one or more layers of a semiconductor device structure, comprising:
moving a polishing pad of the apparatus at least partially away from the subpad;
disengaging a non-adhesive subpad retention element of a subpad support of the apparatus; and
disassembling the subpad from said subpad support.

25. The method of claim 24, wherein said at least partially moving comprises at least partially moving a polishing pad support of the apparatus so as to at least partially move said polishing pad away from the subpad.

5 26. The method of claim 24, wherein said disengaging comprises mechanically disengaging said non-adhesive subpad retention element from a backing of the subpad.

10 27. The method of claim 24, wherein said disengaging comprising disengaging said non-adhesive subpad retention element from at least a portion of a periphery of the subpad.

15 28. The method of claim 24, wherein said disengaging comprises removing from a backing of the subpad a negative pressure applied to said backing through said subpad support.

29. The method of claim 24, further comprising assembling another subpad with the subpad support.

20 30. The method of claim 29, further comprising assembling said another subpad to the subpad support with said subpad retention element.

25 31. The method of claim 30, further comprising moving the polishing pad adjacent the subpad.

32. A method for securing a subpad to a subpad support of an apparatus for polishing one or more layers of a semiconductor device structure, comprising: at least partially moving a polishing pad of the apparatus away from the subpad support; assembling the subpad with the subpad support; and

non-adhesively securing the subpad to the subpad support with a subpad retention element of the subpad support.

5 33. The method of claim 32, wherein said at least partially moving said polishing pad is effected without substantially damaging said polishing pad.

 34. The method of claim 32, wherein said at least partially moving said polishing pad is effected by at least partially moving a polishing pad support.

10 35. The method of claim 32, wherein said assembling is effected by disposing a substantially rigid base on a backing of the subpad against the subpad support.

15 36. The method of claim 32, wherein said assembling is effected by positioning at least a portion of a periphery of the subpad within a lip protruding from the subpad support.

 37. The method of claim 32, wherein said non-adhesively securing comprises at least partially engaging a periphery of the subpad.

20 38. The method of claim 32, wherein said non-adhesively securing comprises mechanically engaging a structure on a backing of the subpad.

 39. The method of claim 32, wherein said non-adhesively securing comprises applying a negative pressure to a backing of the subpad through the subpad support.

ABSTRACT OF THE DISCLOSURE

A subpad support for use in a web format or belt format polishing apparatus for polishing one or more layers of semiconductor device structures. The subpad support includes a subpad retention element for non-adhesively securing the subpad thereto. The subpad support may also include one or more lips protruding therefrom so as to at least substantially inhibit lateral movement of the subpad relative to the subpad support. Polishing apparatus including the subpad support are also disclosed. The polishing pads of such polishing apparatus may be at least partially moved away from the subpad or subpad support so as to facilitate assembly of a subpad with the subpad support or removal of the subpad from the subpad support without damaging the polishing pad. Methods of removably securing a subpad to the subpad support, removing the subpad from the subpad support, and replacing another subpad on the subpad support, as well as polishing methods are also disclosed.

N:\2269\4372\pat.app.wpd 8/30/00

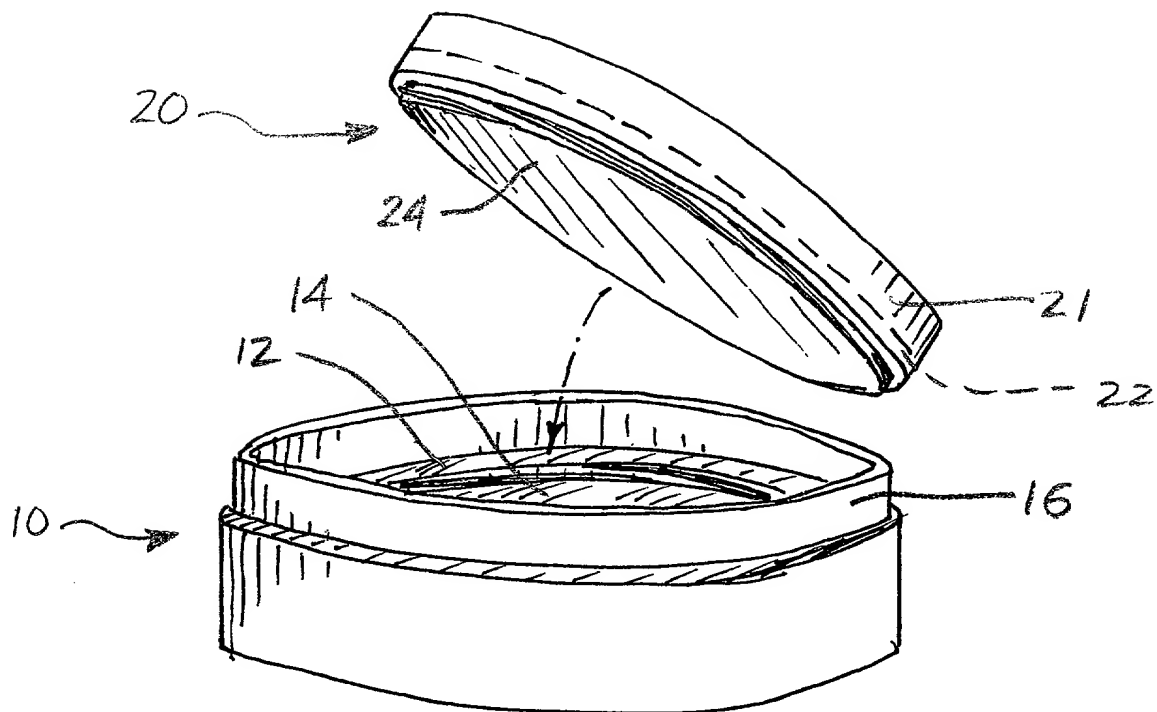


FIG. 1

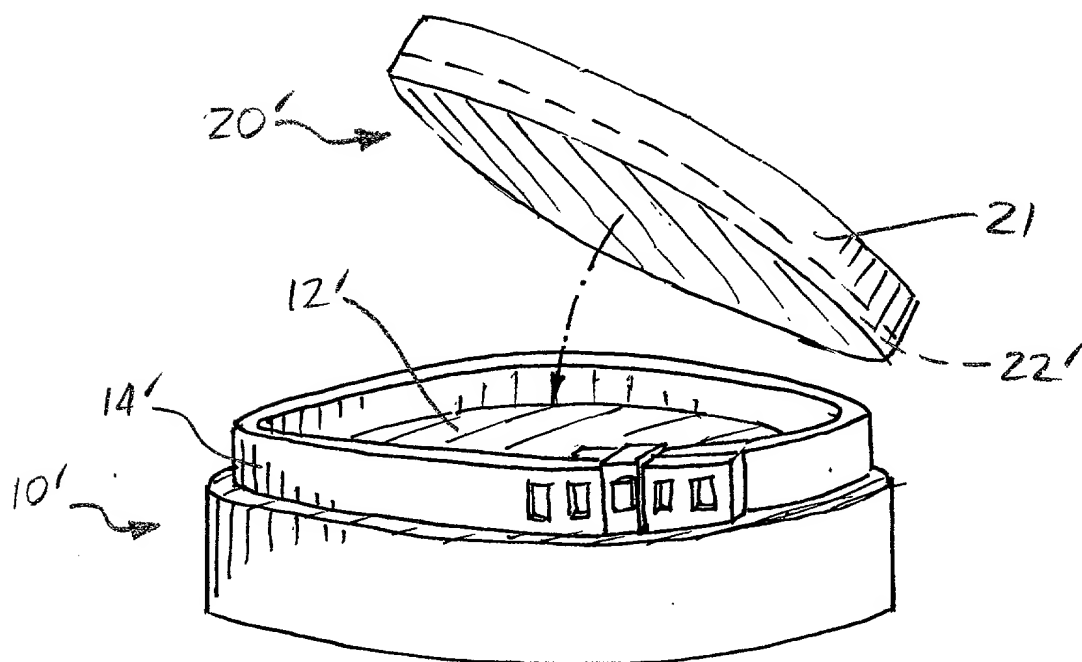


FIG. 2

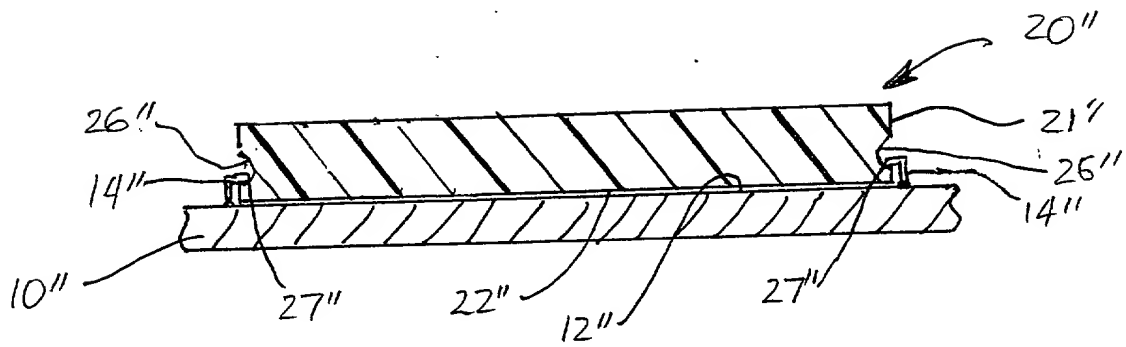


FIG. 3

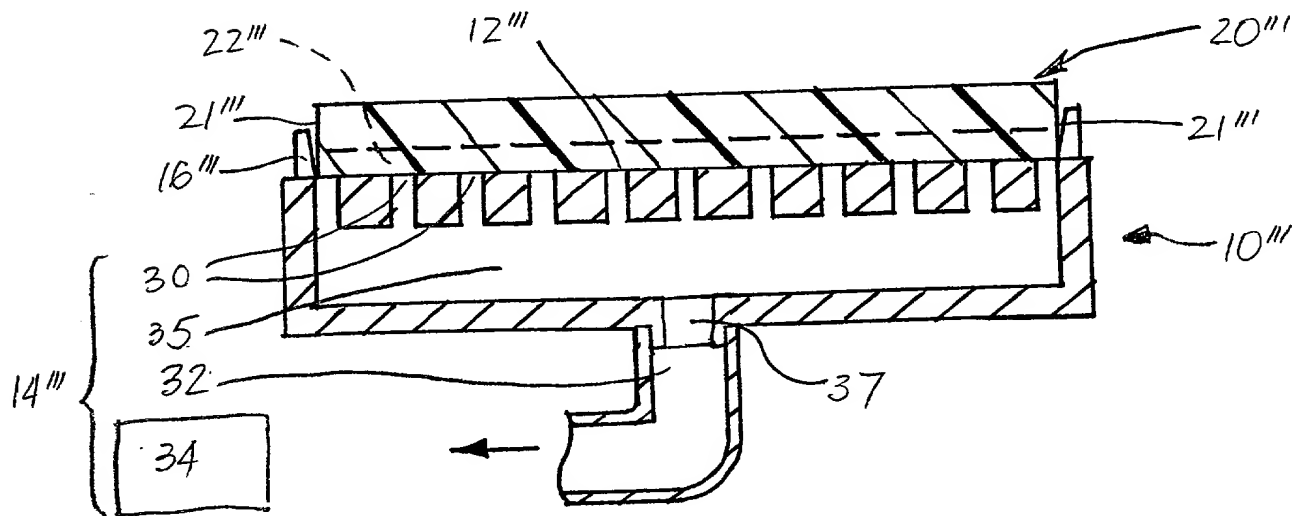
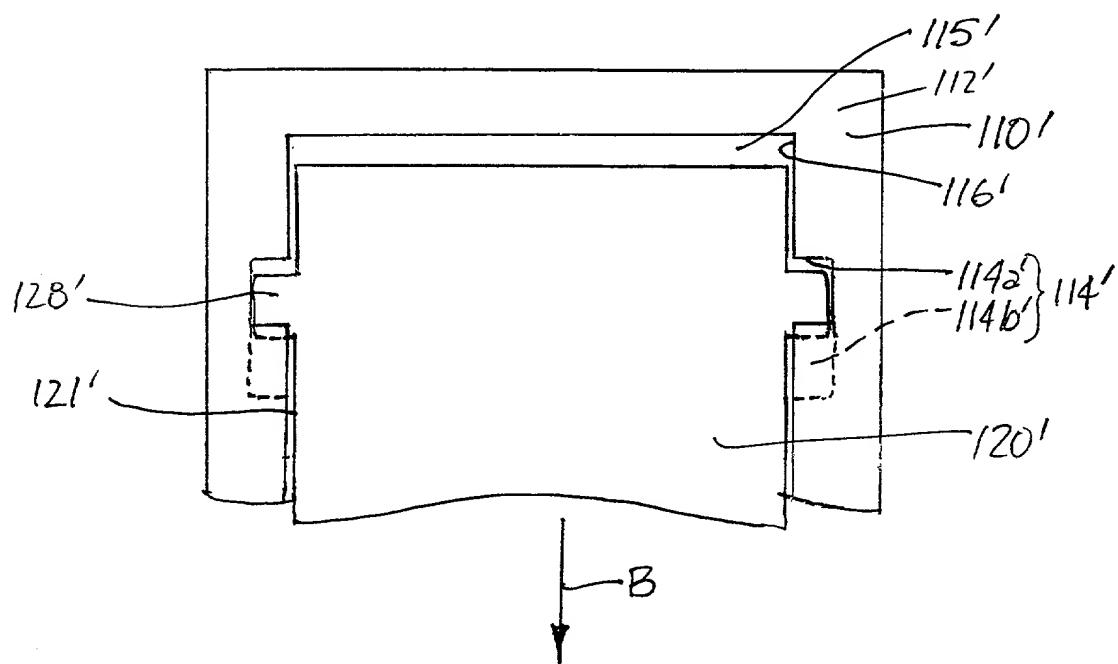
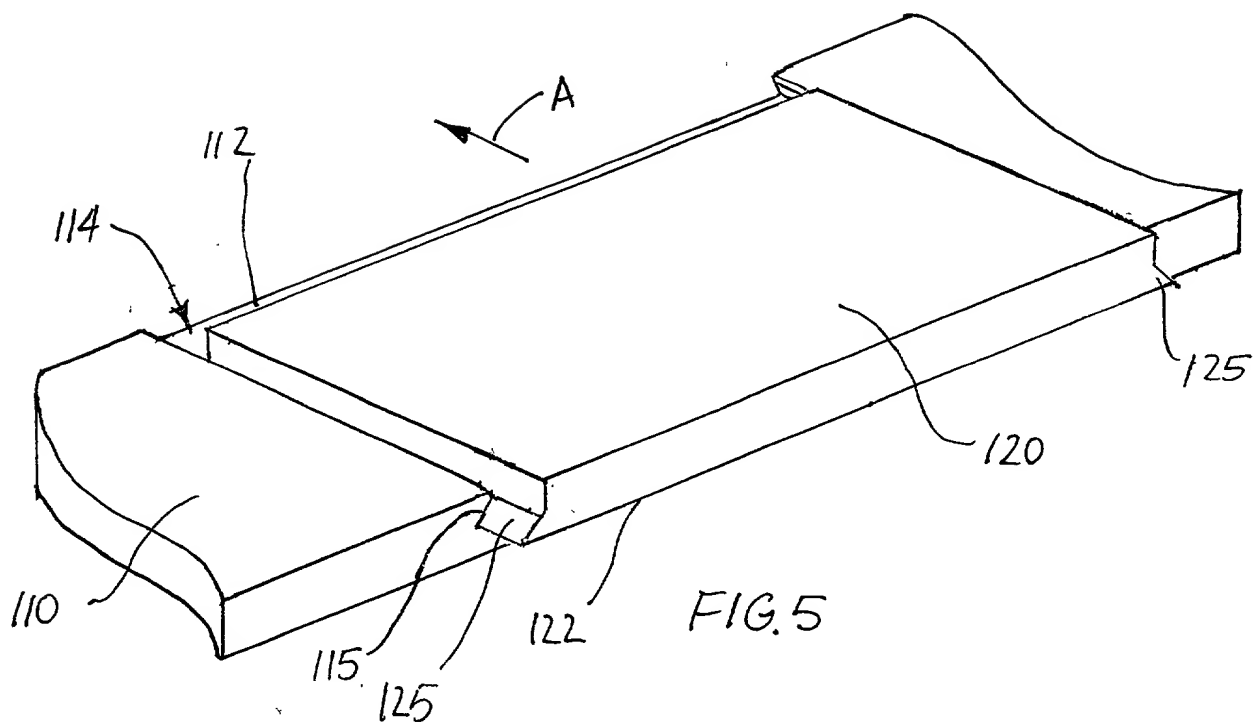
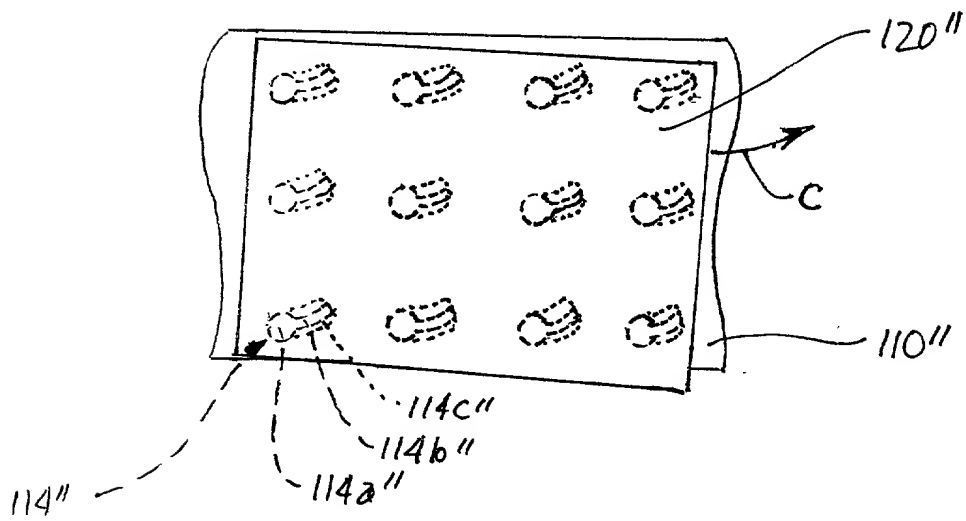
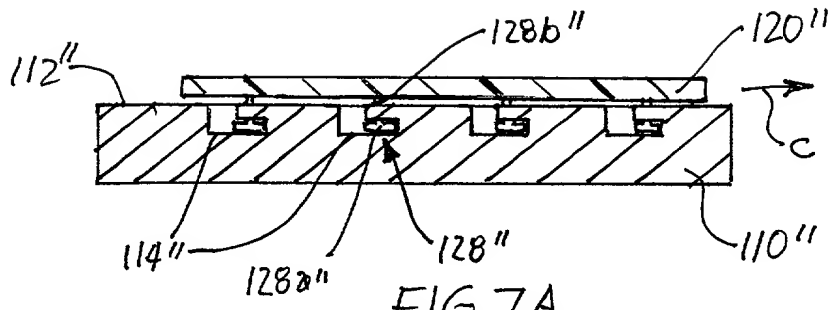
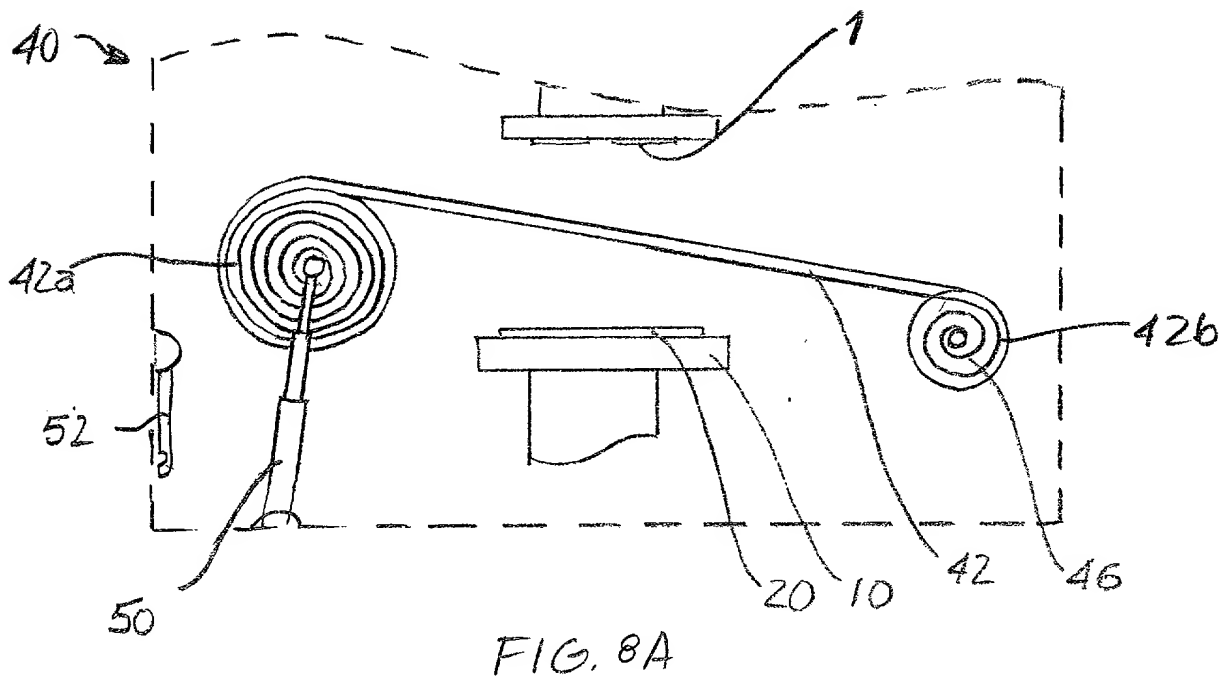
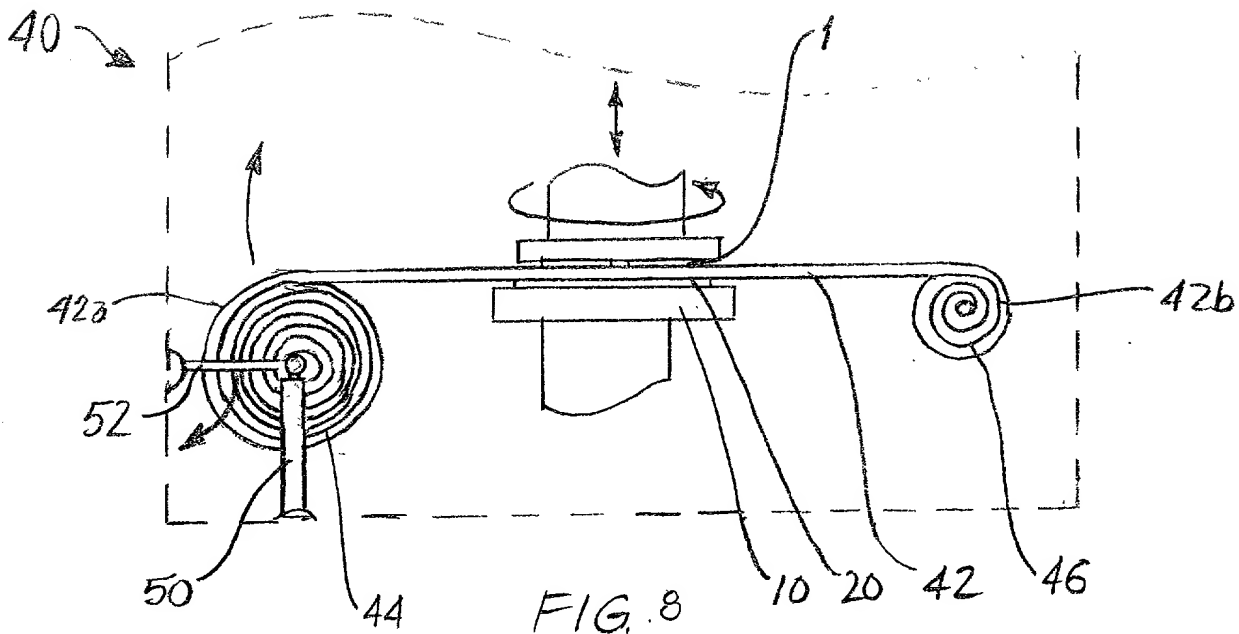
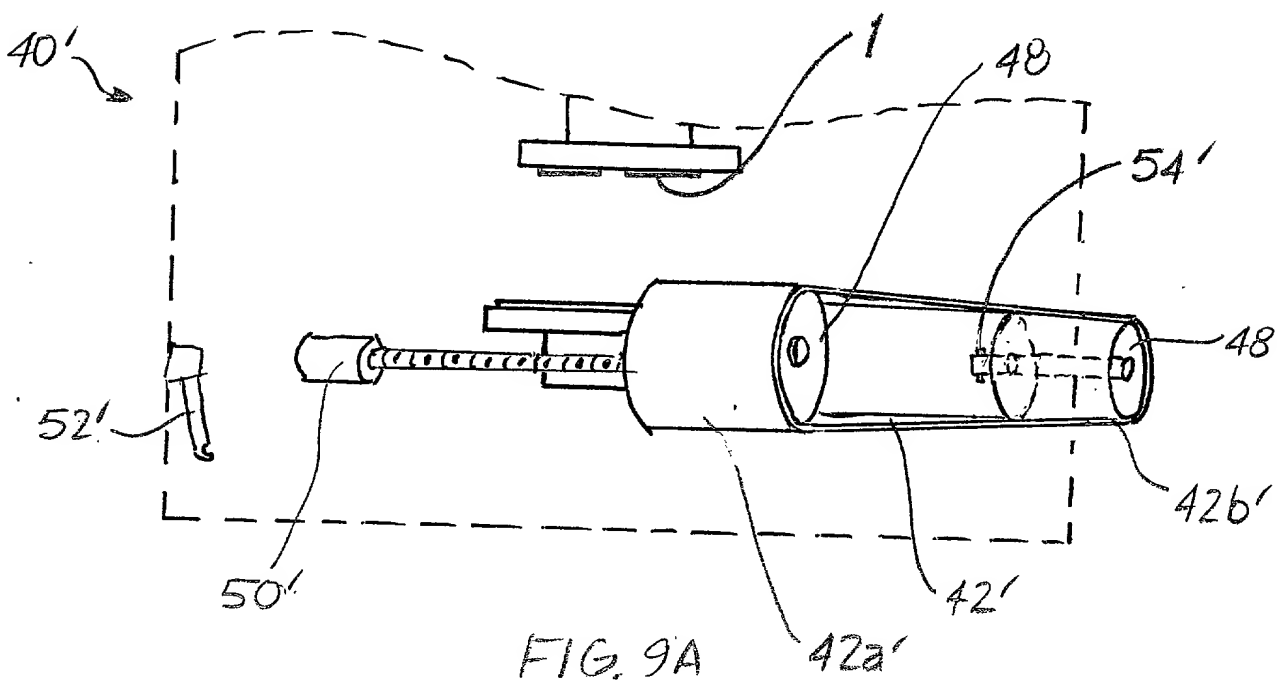
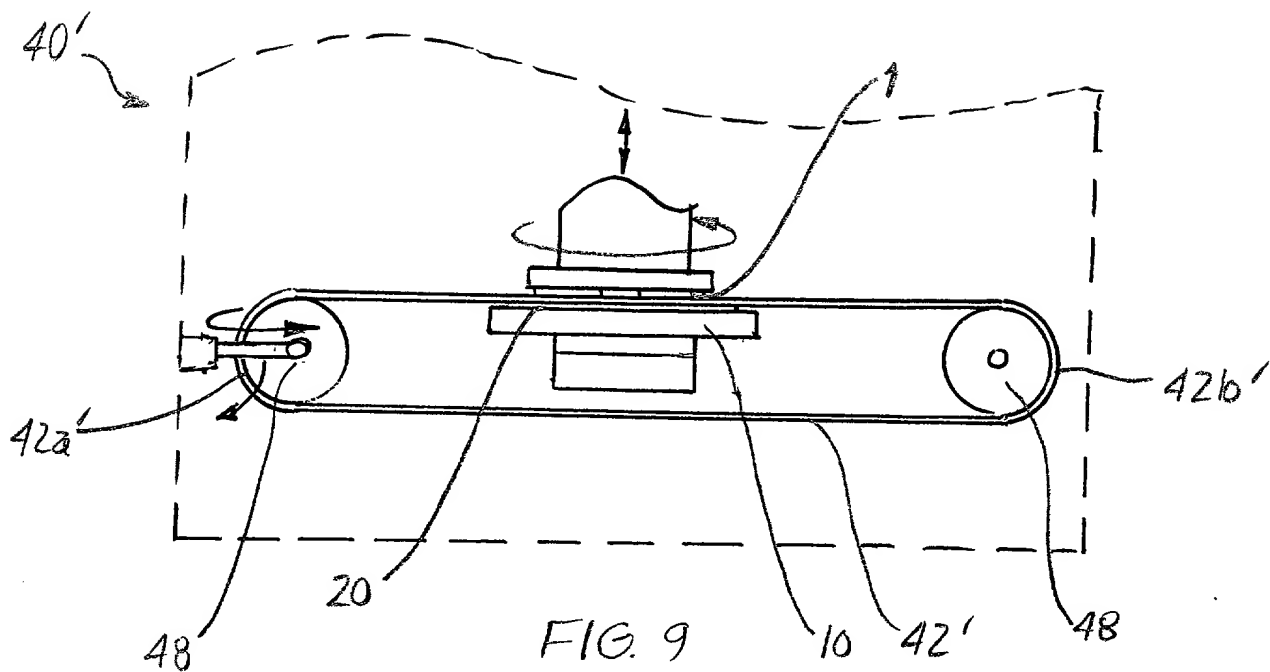


FIG. 4









DECLARATION FOR PATENT APPLICATION (WITH POWER OF ATTORNEY)

As an inventor named below or on any attached continuation page, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled SUBPAD SUPPORT FOR A POLISHING APPARATUS INCLUDING A NON-ADHESIVE SUBPAD SECURING ELEMENT, ASSEMBLIES INCLUDING THE SUPPORT AND A SUBPAD, POLISHING APPARATUS INCLUDING THE SUBPAD SUPPORT, AND METHODS, the specification of which (check one):

☒ is attached hereto.

☐ was filed on _____ as United States application serial no. _____ and was amended on _____.

☐ was filed on _____ as PCT international application no. _____ and was amended under PCT Article 19 on _____.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to the patentability of the subject matter claimed in this application, as "materiality" is defined in Title 37, Code of Federal Regulations § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate or § 365(a) of any PCT international application(s) designating at least one country other than the United States of America listed below and on any attached continuation page and have also identified below and on any attached continuation page any foreign application for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America having a filing date before that of the application(s) on which priority is claimed.

Prior foreign/PCT application(s):

Priority Claimed

(number)	(country)	(day/month/year filed)	Yes	No
_____	_____	_____	_____	_____
(number)	(country)	(day/month/year filed)	Yes	No

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) or § 365(c) of PCT international application(s) designating the United States of America listed below and on any attached continuation page and, insofar as the subject matter of each of the claims of this application is not disclosed in any such prior application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations § 1.56 which became available between the filing date of such prior application and the national or PCT international filing date of this application:

(application serial no.)	(filing date)	(status - pending, patented or abandoned)
_____	_____	_____
(application serial no.)	(filing date)	(status - pending, patented or abandoned)
_____	_____	_____

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

(provisional application no.)	(filing date)
_____	_____

I hereby appoint the following Registered Practitioners to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

David V. Trask, Reg. No. 22,012
Joseph A. Walkowski, Reg. No. 28,765
Edgar R. Cataxinos, Reg. No. 39,931
Brick G. Power, Reg. No. 38,581
Devin R. Jensen, Reg. No. 44,805
David L. Stott, Reg. No. 43,937
Michael L. Lynch, Reg. No. 30,871

William S. Britt, Reg. No. 20,969
James R. Duzan, Reg. No. 28,393
Kent S. Burningham, Reg. No. 30,453
Kenneth B. Ludwig, Reg. No. 42,814
Eleanor V. Goodall, Reg. No. 35,162
Kerry D. Tweet, Reg. No. 45,959
Charles B. Brantley II, Reg. No. 38,086

Laurence B. Bond, Reg. No. 30,549
Allen C. Turner, Reg. No. 33,041
Stephen R. Christian, Reg. No. 32,687
Paul C. Oestreich, Reg. No. 44,983
Samuel E. Webb, Reg. No. 44,394
Bradley B. Jensen, Reg. No. P-46,801

Address all correspondence to: Brick G. Power, telephone no. (801) 532-1922.

TRASK BRITT
P.O. BOX 2550
Salt Lake City, Utah 84110

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole inventor: Theodore M. Taylor

Inventor's signature: Theodore M. Taylor

Residence: Boise, Idaho

Citizenship: U.S.A.

Post Office Address: 2410 Canal Street, #204, Boise, ID 83705

Date: 8/20/99